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Forestry Service

REPORT OF THE COMMITTEE ON THE ECONOMIC IMPACT OF THE SPRUCE BUDWORM IN NEWFOUNDLAND

by:
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E. Burton, Price (Nfld.) Pulp and Paper Limited
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NEWFOUNDLAND FOREST RESEARCH CENTRE
ST. JOHN'S, NEWFOUNDLAND
INFORMATION REPORT N-X-170

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FOREWORD

This report was originally prepared as an internal document for the Forest Improvement Steering Committee which fills a liaison and coordination role for the forest improvement operations of the major forestry agencies in Newfoundland. The Chairman of this committee is the Assistant Deputy Minister of Forestry with the Provincial Government.

After the report was presented to the Steering Committee it was felt by the various member agencies that the contents were of general interest to resource managers and others concerned with the spruce budworm problem. It was agreed that the report should be released as an Information Report of the Newfoundland Forest Research Centre.

ABSTRACT

The present spruce budworm outbreak in Newfoundland started in 1971 and by 1977 it covered about 90 percent of the productive forest area on the Island. The outbreak is still in progress and this report only attempts to quantify certain economic impacts to 1978 and to make some projections for 1979.

Economic impacts are classified as light, moderate, serious and severe and the kinds of costs associated with these various levels are listed. Softwood losses to 1978 for the three major forest limit holders on the Island are given and estimates of possible softwood losses for 1979 in areas with moderate to high hazard rating are presented.

The total cost of direct economic impacts to 1978 has been estimated at $25.7 million, excluding the possible cost of rehabilitation of 32 000 hectares of immature stands that have been seriously damaged. If these rehabilitation costs are included the total cost of impacts to 1978 rises to $48.1 million. Inclusion of other long term transportation and reforestation costs that remain to be quantified will raise the cost of impact still higher. Also, all economic impact costs will continue to accumulate as long as the outbreak lasts and for several years thereafter.

It is recommended that further work be done to estimate economic impacts more precisely and to quantify the effects of the outbreak on the long term wood supplies of the major forest industries.

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The Committee acknowledges assistance received from Dr. B.H. Moody and Dr. A.G. Raske of the Canadian Forestry Service who attended most of the meetings to give advice on budworm population dynamics and impact on forest stands in Newfoundland. Cooperating agencies greatly facilitated the work of the Committee by arranging for their technical staff to make special compilations of inventory data on unsalvagable losses incurred to 1978 and areas and volumes at risk in 1979.

Special thanks go to J. Donnelly of the Canadian Forestry, G. Fugate of the Newfoundland Forest Service, B.H. Frampton and F.W. Rowsell of Price (Nfld.) Pulp and Paper Limited, and W. Strong and C. Garland of Bowater Newfoundland Limited. The Committee also acknowledges the assistance of Miss R.B. Blackmore, Miss M.F. Gillingham and Mrs. D. Didham of the Canadian Forestry Service in typing the interim and final reports.

REPORT OF THE COMMITTEE ON THE ECONOMIC IMPACT OF THE SPRUCE BUDWORM IN NEWFOUNDLAND

INTRODUCTION

The Economic Impact Assessment Committee was formed at the request of the Forest Improvement Steering Committee. At a meeting in Grand Falls in the summer of 1978 the Steering Committee expressed concern about the need for more information on "the effect the budworm is having on the forest today and the implications for the future". The Assessment Committee was activated in the fall of 1978, with J. Munro, Economist of the Canadian Forestry Service, serving as Chairman. Other agency representatives were R. Mercer, Director of Forest Management with the Newfoundland Forest Service, E. Burton, Chief Forester, Price (Nfld.) Pulp and Paper Limited, and W. Dickson, Chief Forester, Bowater Newfoundland Limited.

The Committee met six times between October 1978 and March 1979. The basic approach taken has been to identify the impact that the spruce budworm, Choristoneura fumiferana (Clem.), has had on the provincial forest resource to 1978 and also to compile information on the values at risk in 1979. An interim report was prepared on 12 February at the request of the Department of Forestry and Agriculture to be used in evaluating the need for a spray program on the island of Newfoundland in 1979. This report contains much of the information in the interim report plus additional discussion and analysis of impacts to 1978 and the severity of past and future economic losses.

The Committee wishes to point out at the onset the limited nature of its work. This was caused not only by the fact that Committee members only had limited time to devote to the project but also because of the limited inventory information available on the physical impact the budworm is having on the Newfoundland forest. The inventory section of the Newfoundland Forest Service is carrying out a special survey to provide more accurate estimates of damage for the various forest management units but this analysis was not ready in time to be utilized by this Committee. The Committee thus had to rely on global estimates of impact produced by the Canadian Forestry Service damage assessment survey and on some special compilations supplied by cooperating agencies. These are not expected to be as reliable as the figures to be supplied by the Forest Service. Even the special Forest Service study is not expected to produce a breakdown of budworm losses by accessibility classes, which is the kind of information needed for analysis of economic impact.

GENERAL COMMENT ON THE CURRENT BUDWORM OUTBREAK

The known history of the spruce budworm in Newfoundland has been summarized in a comprehensive report by Otvos and Moody (1978). The progress of the present outbreak has also been outlined in annual reports prepared by the Forest Insect and Disease Survey (FIDS) of the

Canadian Forestry Service. These reports identify the areas infested and in recent years have also presented global estimates of volumes of dead and dying timber by ownership within forest management units. Raske and Rowe (1978) are engaged in a long term impact assessment study on the current spruce budworm outbreak in Newfoundland.

During the past few years high budworm populations have been recorded in parts of Labrador as well as on the Island. A certain amount of defoliation and some mortality has occurred in the Lake Melville area. However, to date losses of timber in Labrador have been limited and the outbreak is expected to collapse in 1979 with moderate to severe defoliation forecast for only a few small isolated areas in the Beaver River and Kenamu River valleys.

While the present outbreak is generally considered to have subsided in most of the western part of the island of Newfoundland, there are still significant areas and volumes at risk in central and eastern regions in 1979. Latest estimates by the Canadian Forestry Service Forest Insect and Disease Survey indicate that 362 000 hectares will be in the moderate to high hazard category in 1979 (Moody, Otvos and Clarke 1978).

It should be emphasized that this is a forecast and large scale larval mortality in the spring could lead to a reduction of this estimate. Alternatively, favorable spring weather for budworm development could lead to a higher level of damage than forecast.

The 'moderate to high' hazard rating indicates that tree vigor has been seriously reduced. Budworm population numbers are still high and one more season of severe defoliation will push many trees past the critical level of defoliation and mortality can be expected in succeeding years. These are the areas that should receive priority consideration for protection in 1979. The FIDS survey also uses a 'very high' hazard rating for dead, moribund and severely damaged stands. Because much of the foliage has been destroyed, these areas are forecast to have low budworm population levels in 1979. They are therefore not considered to be priority candidates for a spray program this year.

KINDS OF PHYSICAL IMPACT

Balsam fir, Abies balsamea (L.) Mill., is the preferred species of the budworm. If only the current growth is destroyed each year, the initial impact is loss of diameter growth of the stem. Increment loss can range from 50 to 90 percent during an outbreak lasting several years. Height growth is also affected, it may be reduced or eliminated through top killing. If the current foliage is destroyed each year,

mortality of trees generally begins in the fourth or fifth year. However, mortality can occur after two years if the old foliage is eaten as well as the current foliage. If 70 percent or more of the total foliage is lost, the tree is considered moribund and is likely to die within 2-4 years.

The impact of the budworm on softwood stands depends largely upon the stand composition and the duration of the outbreak. In a prolonged outbreak, mature stands with a high balsam fir content can be virtually destroyed while stands with a high proportion of black spruce, Picea mariana (Mill.) B.S.P., may receive only light damage because of the ability of spruce to withstand a budworm attack. The killing of the fir component of a fir-spruce stand can have serious consequences (once the salvage period for the dead fir is past) because of the reduction in recoverable merchantable volume per hectare. This will tend to increase logging costs in the future and may render large areas uneconomical to harvest if total recoverable volumes per hectare have been reduced below a merchantability level of, say, 70 m^3 per hectare. Immature stands of balsam fir are also susceptible to attack. To 1978 approximately 32 000 hectares of such stands had been severely damaged.

To summarize, budworm attack can result in loss of diameter and height growth in trees and to mortality if the damage is severe enough. Growth losses and mortality in trees will be reflected by growth losses and mortality in stands. The overall impact on the stand will depend upon the intensity and duration of the outbreak and the composition of the stand.

CLASSIFICATION OF ECONOMIC IMPACTS

The impact of the budworm on the forest economy of a province or region will depend upon the physical factors mentioned above (intensity and duration of attack and composition of the forest), accessibility of damaged stands and on the degree of industrial utilization of the forest resource. If the attack causes only slight loss of growth and/or mortality, the extent of economic losses will be minimal. Similarly, if damage is severe in remote, inaccessible stands that are unlikely to be harvested in the foreseeable future, then direct losses will also be low or insignificant.

In other cases, damage may be enough to cause some reduction in long term allowable annual harvest to industry. However, industrial requirements may still be met by harvesting somewhat more remote and costly wood sources. A more serious situation can also be envisaged in which damage is such that there are substantial reductions foreseen in future allowable harvests and industrial wood supplies from particular areas. Finally, if damage is so severe that wood losses cannot be

replaced at a reasonable cost from within or outside the province, there will be a loss of production in wood harvesting and processing (lumber, newsprint, etc.) and losses in income and employment.

For convenience then, economic impacts may be classified into several broad general groups as follows:

(1) Light Economic Impact

Losses can be either of the following:

- occasional tree losses or loss of growth in some trees but no significant loss of growth in stands
- moderate or severe damage to remote, inaccessible stands.

This kind of damage will not have a significant impact on the level of harvesting in the foreseeable future.

(2) Moderate Economic Impact

Significant growth losses and mortality in economic wood supply areas. Long term allowable annual harvest will be reduced but industrial wood requirement can still be met within the region at somewhat higher cost.

(3) Serious Economic Impact

Future allowable harvests will be reduced to the extent that wood may have to be imported into the area to meet industrial requirements. Wood production for the area will be reduced with losses of employment and income in harvesting operations. Processing operations can be maintained by wood imports from adjacent areas. In this situation, losses of harvesting employment and income in one area will be made up by increases in the level of harvesting in adjacent areas. Future forest based industrial expansion in the area will be depressed because of restricted wood supplies.

(4) Severe Economic Impact

Future wood supplies to the province or region are curtailed and the deficit cannot be replaced by imports either because they are too costly or simply not available. There will be loss of production, employment and income in wood based processing industries on a provincial or regional basis,

as well as in wood harvesting operations. There will be a serious negative impact on forest based industrial expansion within the Province.

Costs Related to Severity of Impact

Various costs that the Committee feels can be associated with the different levels of economic impact are outlined in Table 1. A more comprehensive listing of costs associated with salvaging budworm killed timber is presented by Sewell and Maranda (1978) in their report for the Forest Engineering Research Institute of Canada. The authors point out that there are typically a number of phases to a budworm outbreak. There is usually a two-year warning period when insect populations are building up in the area. There is a 3-4 year period of defoliation, after which significant mortality begins to occur. Following this, there is a 3-4 year period when killed timber can be salvaged. Thereafter, salvage operations are no longer practical because of poor timber quality and high cost of harvesting and processing.

ASSESSMENT OF SOFTWOOD LOSSES TO 1978

Assessment of softwood losses caused by the spruce budworm to 1978 is complicated by the fact that some of the forest stands affected by the budworm were also damaged during a hemlock looper (Lambdina fiscellaria fiscellaria (Guen.)) outbreak that occurred in Newfoundland in the late 1960's. Some of the mortality attributed to the spruce budworm in this report has actually been caused by the hemlock looper. An accurate estimate of the mortality caused by the hemlock looper was not available at the time of writing but, overall for the Island, it is not expected that it would account for more than 20 percent of the volume of timber presently listed in the dead category.

According to damage assessment surveys carried out by FIDS (the Forest Insect and Disease Survey), 300 400 hectares (742,000 acres) with a total merchantable softwood volume of 22.4 million m^3 (9.3 million cords), has received serious damage to 1978. Total dead and moribund timber in these stands is estimated at 11.4 million m^3 (4.7 million cords). These stands are predominantly balsam fir, much of which is at or near the critical level of defoliation of 70 percent. The amount of timber in the dead and dying category in these stands may very well increase over the next few years.

The total volume of balsam fir on the Island is estimated at 137.5 million m^3 (57.1 million cords) in the provincial global forest inventory (Anonymous, 1974). The total volume of softwood on the Island is estimated at 281.7 million m^3 (117 million cords). Thus, the total

Table 1. Listing of levels of economic impact.

Level of economic impact	Associated costs to region or province
1. Light	- low
2. Moderate	- modest increase in wood cost due to salvage - modest increased cost of processing dead timber
3. Serious	- loss of stumpage values in standing timber - growth losses - disruption of normal logging operations - increased cost of salvage harvesting - increased transportation costs* - increased cost of processing dead timber - cost of special forest protection measures - cost of spruce budworm research, damage assessment surveys, environmental monitoring, etc. - cost of forest rehabilitation
4. Severe	- loss of stumpage values in standing timber - growth losses - disruption of normal logging operations - increased cost of salvage harvesting - increased wood transportation costs* - increased cost of processing dead timber - lost production, employment and income in harvesting - lost production, employment and income in processing - cost of special protection measures - cost of spruce budworm research, damage assessment surveys, environmental monitoring, etc. - cost of forest rehabilitation

*Transportation costs are not necessarily more expensive in the short run, especially if the wood being salvaged is close to utilization plants. However, because of the location of much of the dead and dying timber, the overall effect of the outbreak in Newfoundland in the long run should be to increase wood transportation costs.

volume of mortality to date is roughly equivalent to eight percent of the total volume of balsam fir on the Island. The total volume in dead, moribund and severely damaged stands is equivalent to about 16 percent of the total volume of balsam fir and about eight percent of the total softwood volume on the Island.

The above are global estimates for the Island and are, perhaps, not very meaningful because they do not say much about the impact of losses on the individual limit holders, within their important wood supply areas. The Committee asked the cooperating agencies to compile an assessment of losses for the main management units affected by the budworm according to a format showing total volume in dead and moribund stands (category A and B in FIDS survey), estimated volume to be salvaged and estimated volume that would not be salvaged. The latter volume was divided into accessible and inaccessible* classes. The results are discussed below.

Bowater and Price

A summary of the statistics for selected units held by Bowater is presented in Table 2. The total merchantable volume in dead and moribund stands (category A and B stands in FIDS survey) on Company held limits in these management units is about 5.795 million m^3 (2.405 million cords). Of this, it is presently estimated that 2.661 million m^3, or 46 percent will be salvaged. Of the remaining 3.134 million m^3 that will not be salvaged, only 0.713 million m^3 is classed as accessible by the Company. Thus, of the total volume in dead and dying stands, only about 12 percent is accessible timber that will not be salvaged. Some of this accessible timber has been allocated to another party and is not available to the Company. The balance is expected to be lost because it will not be harvested within the 5-year salvage period.

The situation for Price limits is summarized in Table 3. Of the total volume of 1.902 million m^3 estimated by the Company for class A and B stands, 1.404 million m^3 or 74 percent will be salvaged. Of the remaining 0.498 million m^3 that will not be salvaged, 0.323 million m^3 is considered to be accessible. Thus, of the total volume in dead and moribund stands on Price limits, 0.323 million m^3 or 17 percent is accessible timber that will not be salvaged. Most of this accessible timber is not available to the Company because it has been allocated by agreements to other parties.

Taken together, for the management units most seriously affected, the Companies have a total volume of 7.697 million m^3 (3.194 million cords) in dead and moribund stands. Of this, 4.065 million m^3 (1.687

*Timber was classified as inaccessible if harvesting and transportation costs were estimated to be prohibitive because of topography (usually steep slopes), remoteness from the existing transportation network, or for some other reason.

Table 2. Summary of timber losses to Bowater
(volumes in 1,000 m^3)

Management unit	Total volume in dead and dying stands	Estimated volume that will be salvaged	Estimated volume that will not be salvaged		
			Total	Accessible	Inaccessible
9	312	242	70	-	70
14	2254	1552	702	374	328
15	1981	567	1414	239	1175
16	848	-	848	-	848
17	400	300	100	100	-
Totals	5795	2661	3134	713	2421

Table 3. Summary of timber losses to Price
(volumes in 1,000's m^3)

Management unit	Total volume in dead and dying stands	Estimated volume that will be salvaged	Estimated volume that will not be salvaged		
			Total	Accessible	Inaccessible
4	276	-	276	244	32
5	43	8	35	35	-
9	890	777	113	18	95
11	173	173	-	-	-
12	416	416	-	-	-
13	104	30	74	26	48
Totals	1902	1404	498	323	175

million cords) or 53 percent is expected to be salvaged. Of the balance, 1.036 million m^3 (0.430 million cords) or 13 percent is accessible wood that will not be salvaged. The remaining 34 percent is not considered accessible by the Companies.

Non Alienated Crown Lands

A summary of statistics for expected timber losses due to damage caused by the budworm to 1978 for non alienated crown lands is contained in Table 4. The total merchantable volume in dead and moribund stands for the management units listed is 4.554 million m^3 (1.890 million cords). Of this, 1.424 million m^3 (0.591 million cords) or 31 percent is expected to be salvaged. Of the remaining 3.130 million m^3 (1.299 million cords) that will not be salvaged, 70 percent is considered to be accessible. The reason such a high proportion is not expected to be harvested is because it is dispersed over a wide area and only limited local markets exist for salvage wood.

Summary of Losses Incurred to 1978

A summary of estimated volumes in dead and moribund stands in 1978 by ownership (for the management units listed in Tables 2, 3 and 4) is contained in Table 5. Of the total volume of 12.251 million m^3 (5.083 million cords), approximately 45 percent is expected to be salvaged. Of the 6.762 million m^3 (2.806 million cords) that will not be salvaged, 48 percent is considered to be accessible and 52 percent is considered inaccessible by the agencies responsible for the limit areas.

The important figure for estimating value of timber losses is the volume of accessible wood that will not be salvaged. This volume is approximately 3.237 million m^3 (1.343 million cords) and accounts for 26 percent of the total softwood volume in dead and dying stands.

Growth Losses

A rough estimate* was prepared of growth losses for 1978, based on the areas listed in the A, B, C, D, FIDS damage classes and immature stands. The total area involved in 1978 was 1.295 million hectares (3.199 million acres) and the total increment loss was estimated at 1.098 million m^3 (0.456 million cords). Losses for 1977 were similarly estimated at 1.424 million m^3 (0.591 million cords). These were higher than for 1978 because there was significantly more area exposed to damage in 1977 than in 1978. Total growth losses for 1977 and 1978 were, therefore, estimated at 2.522 million m^3 (1.046 million cords).

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*An average growth rate of 1.47 m^3/ha/year was applied to the area in each damage class to estimate normal annual increment. The increment for each class was reduced by from 50 to 90 percent depending upon the class. The reductions for each class were summed to get total estimated annual growth losses.

Table 4. Summary of timber losses on non alienated crown lands (volumes in 1,000 m^3)

Management unit	Total volume in dead and dying stands	Estimated volume that will be salvaged	Estimated volume that will not be salvaged		
			Total	Accessible	Inaccessible
1	67	-	67	67	-
2	8	-	8	8	-
7	417	390	27	27	-
8	48	-	48	48	-
9	456	142	314	303	11
14	2025	360*	1665	1133	532
15	401	57**	344	132	212
16	899	350***	549	447	102
17	233	125	108	36	72
Totals	4554	1424	3130	2201	929

*Assumes 200 000 m^3 will be salvaged for the Stephenville mill.

**Assumes 30 000 m^3 will be salvaged for the Stephenville mill.

***Assumes 200 000 m^3 will be salvaged for the Stephenville mill.

Note: The accessibility classification is mainly on the basis of stands on slopes greater than 30 percent being technologically inaccessible.

Table 5. Summary of timber losses for major ownerships for dead and moribund stands in selected management units (volumes in 1,000's m^3)

Ownership	Total volume in dead and dying stands	Estimated volume that will be salvaged	Estimated volume that will not be salvaged		
			Total	Accessible	Inaccessible
Bowater	5795	2661	3134	713	2421
Price	1902	1404	498	323	175
Crown	4554	1424	3130	2201	929
Totals	12251	5489	6762	3237	3525

ASSESSMENT OF AREAS AND VOLUMES AT RISK IN MODERATE TO HIGH HAZARD AREAS IN 1979

As already indicated, moderate to high hazard areas for the Island for 1979 have been identified by the FIDS Survey. These are the areas considered by the Committee to have priority for protection in 1979 because insect numbers are forecast to be high and the trees are at a critical level of defoliation.

The survey identifies areas on 1:250,000 maps and does not attempt to provide estimates of wood volume on these areas. Also, the FIDS figures contain areas of recent cutover (and possibly some burned areas) as well as productive forest area supporting merchantable stands. Since we were interested in an estimate of merchantable softwood volume at risk, it was necessary to refine the FIDS survey figures to identify only those productive areas supporting merchantable stands.

Moderate to high hazard areas (as identified by FIDS) are identified as slant hatched areas on the map in Figure 1.

The Newfoundland Forest Service undertook to provide volume estimates for forecasted high hazard areas for 1979. Areas outlined on the FIDS survey maps were transferred to larger scale forest type maps and estimates were prepared of merchantable forest area and softwood volumes for height class 30 feet and over. For each ownership within each management unit, estimates were calculated for 'balsam fir' and 'total softwood' by slope class (greater than or less than 30 percent). This information is summarized in Table 6 for areas and volumes in slope class less than 30 percent. Only 1 774 hectares were identified on slopes greater than 30 percent. These areas are omitted from the following discussion.

The total area in the moderate to high hazard category for 1979 is approximately 297 507 hectares (734,842 acres) containing approximately 18.7 million m^3 (7.8 million cords) of softwood (Table 6). Of this, eight million m^3 (3.3 million cords), or 43 percent is balsam fir. It should be noted that these are total figures and all the hazard areas included might not be candidates for a protection program in 1979, because of proximity to settled areas, small size and isolated location. The areas and volumes listed in Table 6 are additional to those already classified in the dead and moribund categories to 1978.

The main impact of the budworm in the moderate to high hazard areas for 1979 will be on balsam fir in central and eastern Newfoundland. As the figures in Table 6 indicate, removal or loss of the fir component would have the effect of reducing the average stand volume from 28 to 82

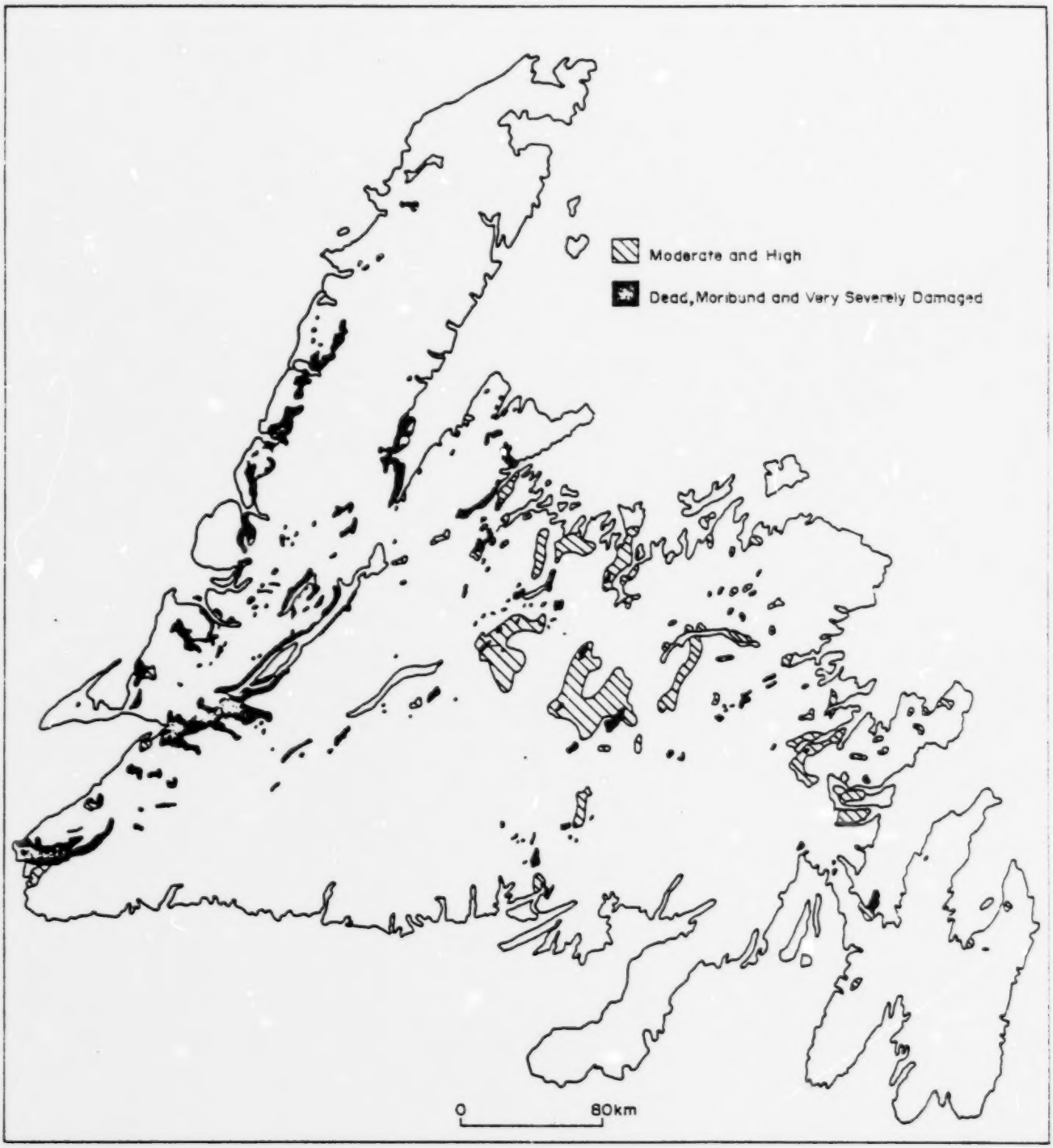

Figure 1. Areas of dead, moribund and very severely damaged stands and forecast of moderate and high hazard areas with high populations for 1979.

Source: FIDS Survey.

Table 6. Summary of areas and volumes by management unit in moderate to high hazard areas for 1979 on slopes < 30%

Management unit	Area (hectares)	Softwood volume (1,000's m^3) bF	Total	% bF by volume	Total volume/ hectare*	Volume/ hectare without bF
1	10 429	156	242	64	23	8
2	27 417	824	2 105	39	77	47
4	3 632	74	232	32	64	44
5	16 158	297	849	35	52	34
6	39 236	956	2 690	36	68	44
7	11 326	710	894	79	79	16
8	17 359	412	1 099	37	63	40
9	19 712	655	1 919	34	97	64
10	24 674	724	2 536	28	103	73
11	86 775	1 291	3 502	37	40	25
12	11 924	446	725	62	61	23
14	10 494	870	1 055	82	100	18
15	17 351	633	840	75	48	12
16	1 020	33	45	73	44	12
Totals	297 507	8 081	18 733	43	63	36

*The volume per hectare figures may appear low but this is because volumes are included for stands of height class 30 and over. Thus, immature as well as mature stands are included and this tends to lower the average volume per hectare figures.

percent. For many mature stands, the volume per hectare could be reduced below the level normally considered practical to harvest.

It should be noted that losses are expected in the moderate to high hazard areas even if a successful spray program is initiated in 1979. In this case, losses should be limited to 10 percent of the balsam fir volume on the areas sprayed.

DISCUSSION OF ECONOMIC IMPACTS TO 1978

In attempting to determine economic impacts, the Committee has become very conscious of the dynamic nature of a budworm outbreak and the difficulty of getting accurate information on its past, present and likely future effects on the forest resource. Assessment of past and present damage is difficult enough but estimation of future impact is especially risky because of the many unpredictable variables involved.

With reference to the various levels of economic impact outlined in Table 1, the Committee is of the opinion that the western region has passed through stages 1 and 2 and is now at stage 3. Further, it is felt that this region will move into the level 4 category within the next 10 years, if mortality continues as expected. The central region has passed through level 1 and was at level 2 in 1978, as far as extent of timber losses is concerned. (Certain management and protection costs listed for level 3 were being incurred in 1978.) Level 3 could be reached for the central region in 1979, if protection is not provided and the outbreak continues as expected. Comments on the various cost items listed for serious and severe impact levels in Table 1 follows.

Loss of Stumpage Values

Stumpage values are only considered to be lost if the salvage timber is accessible and will not be utilized. The quantity of timber in this category to 1978 was estimated (Table 5) at 3.237 million m^3 (1.343 million cords). This represents a loss of $4.046 million at a value of $1.25* per m^3.

The fact that the amount of dead and dying timber now exceeds the quantity that will be salvaged, means that any additional mortality in economically accessible supply areas, will result in additional stumpage losses. The total softwood volume in moderate to high hazard areas for 1979 has been estimated at 18.7 million m^3. The balsam fir component of these stands is estimated to be 8.1 million m^3. These moderate to high hazard areas will likely experience 10 percent mortality of balsam fir regardless of whether or not they are protected by spraying in 1979. However, if spraying is not carried out in 1979, and if severe defoliation continues, an additional 65 percent mortality of fir volume is forecast over the next three years. This would represent the loss of an additional 5.3 million m^3 with a value of $6.6 million. Thus, the value losses of balsam fir are estimated at $6.6 million if protection is not provided in 1979.

Losses would be higher than $6.6 million because loss of the fir component of the mixed stands would render large areas uneconomical to harvest. Because of this effect, it is felt that up to 65 percent of

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*There is no average market determined price for stumpage in Newfoundland. This is an administered value set under the Forest Land (Management and Taxation) Act of 1974 and the regulations made under the Act.

the total volume of 18.7 million m^3 (7.8 million cords) in the moderate to high hazard areas could be lost. Thus, in the absence of spraying, additional losses could range anywhere between 5.3 million m^3 with a value of $6.6 million, to 12.2 million m^3 with a value of $15.2 million. Actual losses would probably be closer to the midpoint of this range ($10.9 million) than to the upper or lower limits.

Value of Growth Losses

Growth losses estimated for 1977 and 1978 were 2.522 million m^3 (1.046 million cords). Applying an average stumpage value of $1.25 per m^3 gives an estimated value loss of $3.153 million for these two years.

Disruption of Normal Logging Operations

The available information applies mainly to company limit areas. Both Bowater and Price have experienced additional costs because of disruption of logging operations. Costs were incurred when roads and camps constructed for normal planned operations had to be abandoned because of the need to divert the logging force to salvage harvesting in other areas. Costs will be experienced when these abandoned areas are reactivated sometime in the future. There is also the cost of starting up new salvage harvesting operations on short notice.

Although a detailed analysis has not been undertaken, it is thought that the increased costs experienced by the companies for disruption of these logging operations have been offset by special government assistance provided for access roads constructed into salvage areas. The cost of this program for roads constructed and planned to 1978 is approximately $2.322 million.

Increased Cost of Salvage Harvesting

Costs of salvage harvesting of budworm killed timber have not been high to date but are expected to increase in the next few years. After mortality, sap rot develops, trees become light and brittle and tend to break easily. The result is reduced productivity and higher costs of harvesting. Sewell and Maranda (1978) reported that the magnitude of the cost increase depended to some extent on the harvesting system used. They reported the following range of increased costs for an eight foot cut and bunch harvesting operation, for a stand having 20-40 percent mortality:

1.	Added cost due to breakage	$0.20 - $0.35 per m^3
2.	Added cost for recovery of broken tops	0.20 - 0.20 "
3.	Increased cutting rates because of deterioration of wood	0.35 - 0.70 "
	Totals	$0.75 - $1.25 per m^3

The authors noted that such costs could vary widely depending upon local conditions. In view of the above, it probably would be reasonable to tentatively estimate an average increased harvesting cost of $1 per m^3 for salvage wood in Newfoundland. The estimated quantity of timber in dead and moribund stands to 1978 that will be salvaged is 5.489 m^3 (2.234 million cords) (Table 5). The approximate increased cost of salvage harvesting would be, therefore, approximately $5.489 million.

Transportation Costs

Transportation costs can be reduced or increased, depending upon the circumstances. For salvage operations, trucking costs can be significantly reduced if the basis for payment is weight of the load. If the basis for payment is volume, costs can increase if the volume transported per load decreases. River driven wood could be subjected to higher than normal sinkage losses (Sewell and Maranda, 1978). If salvage operations are located closer to the plant than normal operations, there can also be transportation cost savings in the short run. However, the long run impact of timber losses close to plants will be to increase transport costs as more remote areas will have to be harvested. Detailed information on the probable impact of the current outbreak on transport costs was not available for this report.

Processing Costs

The cost of processing insect killed timber increases with the time interval since mortality. Sewell and Maranda (1978) quoted figures indicating that the cost of processing wood dead (from the hemlock looper) for these three years was about two percent of the cost of wood used in the newsprint furnish. For wood killed six years, the increased wood cost rose to 23 percent which was considered prohibitive.

In the case of wood killed for three years, if a wood cost of $25 per m^3 is assumed ($60 per cord), the increased cost would be about $0.50 per m^3. A rapid increase in cost would take place after year three. Simple proration to year four puts the cost increase at about nine percent (or $2.25 per m^3) and 16 percent ($4 per m^3) in year five.

The Committee calculated that the average increased processing costs of the insect killed wood to be salvaged over a five year period would be $1.18 per m^3. The increased cost of processing of 4.065 million m^3 for the pulp and paper companies would be 4.797 million. The increased cost of processing for the 1.424 million m^3 to be salvaged on non alienated crown lands is also estimated at $1.18 per m^3, or $1.680 million. Total increased processing cost is, therefore, $6.477 million.

Cost of Special Forest Protection Measures

The Province carried out an experimental spray program in 1977 at a cost of approximately $1.050 million, not including certain costs for wages and expenses of permanent staff. In 1978 the cost of the operational spray program was $2.634 million, again not including a small proportion of certain permanent staff, but including the operational cost of the environmental monitoring program. The average cost for the operational spray program for 1978 was $6.42 per hectare ($2.60 per acre). The cost of a program for 1979 would likely be in the vicinity of $6.80 per hectare. A spray program for 300 000 hectares would, therefore, cost about $2.0 million.

The total approximate cost of special spray programs in 1977 and 1978 against the spruce budworm in current dollars is $3.684 million.

Cost of Damage Assessment Surveys and Research

The annual cost (shared by the provincial and federal governments) of the FIDS surveys carried out to monitor budworm populations and forecast damage was approximately $145,000 in 1978. In addition, a substantial portion of the protection research staff of the Canadian Forestry Service in Newfoundland is now devoted to budworm related work. The cost of this research effort for 1978 was approximately $135,000. Estimated cost for damage assessment surveys and research was thus $280,000 for 1978. Cost for 1977 for these activities would have been about the same, so the total cost for both years is estimated at $560,000.

Possible Cost of Forest Rehabilitation

The Committee has not been able to evaluate this aspect of impact in any detail. Some mature fir stands killed by the budworm may have sufficient survival of advance regeneration to provide for the establishment of a new stand while others may not. If natural regeneration does take place, the new stand will be balsam fir. If it is decided to convert these stands to other species, then major costs in excess of $500 per hectare would be incurred.

The FIDS survey indicates that there are 32 000 hectares of immature balsam fir in western Newfoundland that had received very severe damage to 1978. Assuming there is 100 percent mortality in this area and there is no natural regeneration (no advance growth or seed sources), the existing stand will have to be removed and replaced by planting, if these sites are to be put back into softwood production. Cost of stand removal and replanting with bare root stock would amount to at least $700 per hectare. Treatment cost for the whole area, should it be necessary, would amount to at least $22.4 million. This is an estimate of the replacement cost for these immature stands. However, it was not certain at the time of writing that artificial regeneration would be needed over all of this area to ensure adequate stocking to softwood species.

Possible Costs of Lost Production and Income

Although the present spruce budworm outbreak has not yet caused any reduction in output and employment in local forest based industry, there is always the possibility, in a severe outbreak, that such an impact could occur in future. The Committee is seriously concerned about the possibility of future wood shortages for western Newfoundland in about 10 years time that would be attributed to repeated attacks by insects including the spruce budworm. Restriction of wood supply to the pulp and paper mills would have a serious economic impact on provincial income. There would be reduced income and employment in both timber harvesting and in processing. To give some idea of the magnitude of these losses, Table 7 was prepared showing current value added estimates per m^3 of wood harvested and processed in Newfoundland.

As can be seen from the table, the contributions to provincial income from the harvesting and processing of a m^3 of pulpwood are significant. If the annual wood supply to the pulp and paper industry was reduced by 100 000 m^3 because of the spruce budworm outbreak, this would represent an annual loss of $2.183 million in value added to the logging industry, including a $1.4 million loss in wages and salaries to woods workers. Similarly, a $4.430 million loss in value added would be experienced by the pulp and paper mills, including a $1.911 million loss in wages and salaries for mill workers.

The above figures also give some idea of the possible cost of a budworm outbreak in terms of foregone industrial expansion. If, without the budworm, an additional 100,000 m^3 annually could be harvested and processed in the future, the related increased income would accrue to the provincial economy.

Table 7. Some estimates of value added[1] for 1 m^3 of pulpwood harvested and processed in Newfoundland in 1979.

Item	Value per m^3 ($)
Total value added, logging	21.83
- wages and salaries	14.01
- other income[2]	7.82
Total value added, processing	44.30
- wages and salaries	19.11
- other income	25.19

[1]Value added, manufacturing activity is the value of shipment of goods of own manufacture plus net change in inventory of goods in process and finished goods, less cost of materials and supplies used, fuel and electricity.

[2]Other income, includes industry rent, depreciation and profits and federal and provincial corporate income taxes.

Note: Estimates are based on Statistics Canada (25-202) data for 1975 on pulpwood shipments (2.223 million m^3) and value added for the logging and pulp and paper industries. A rate of 7.5 percent was used to inflate to 1979.

Summary of Economic Impacts to 1978

A listing of the economic impacts that have been quantified for damage incurred to 1978 is contained in Table 8. Two things need to be stressed. The values are only estimates (based on assumptions outlined in the foregoing discussion) subject to further refinement and the list does not quantify all the impacts. The table does give an idea of the magnitude of the damage being caused by the current spruce budworm outbreak.

Not all of the costs listed in the table had been incurred by 1978. The increased costs for salvaging and processing dead timber will be mainly felt in the next few years. The table does not include the value of stumpage losses that could be experienced in 1979. Nor does it include costs of spray programs, damage assessment surveys and research for 1979 and after. The increased transportation cost that will likely

Table 8. Summary of economic impacts and estimated costs for damage incurred to 1978.

Item	Estimated cost ($ millions)
1. Loss of stumpage values to 1978 for accessible wood in dead and moribund stands that will not be salvaged.	4.046
2. Value of growth losses for 1977 and 1978.	3.153
3. Disruption of normal logging operations.	2.322
4. Increased cost of harvesting dead and moribund timber that will be salvaged.	5.489
5. Increased processing costs for wood that will be salvaged.	6.477
6. Cost of spray programs for 1977 and 1978.	3.684
7. Cost of damage assessment surveys and research for 1977 and 1978.	0.560
Total	25.731

be experienced in the future because of the outbreak has not been quantified. No estimate has been included for possible costs of reforestation of insect killed areas that may not regenerate naturally. Future growth losses have not been quantified. The possible impacts on transportation and reforestation are considered serious, but further study is required to get reasonable estimates of the costs involved. Finally, the table does not include any estimate for losses of income and employment because of possible wood shortages in the future. Again, it is felt that more study is required.

If the possible cost of forest rehabilitation for the 32 000 hectares of immature stands is added to the costs in Table 8, the total impact estimate is increased to $48.1 million. The figure for rehabilitation cost was not included in the table because of the very tentative nature of the estimate.

Summary of Economic Impacts for 1979

The Committee has not quantified all the economic impacts that could occur in 1979. Those which it feels can be tentatively estimated are discussed below.

Growth losses will again be considered in 1979. The area of moderate to severe defoliation is estimated by FIDS to be 931 874 hectares. For this area alone, growth losses are estimated to average 0.85 m^3 per hectare or 792 000 m^3. The value of these losses at $1.25 per m^3 is approximately $1 million.

Stumpage value losses could vary greatly depending on the degree of protection provided. If all the moderate to high hazard areas are protected, losses should be restricted to about 10 percent of the volume of balsam fir or 0.81 million m^3 (0.34 million cords) with a value of $1.01 million. If protection is not provided, additional losses are estimated to be between $6.6 million and $15.2 million, the mid-point of which is $10.9 million.

If a spray program is carried out in 1979 for 300 000 hectares, the estimated cost would be $2.0 million. Cost of damage assessment surveys and research is estimated at $280,000.

CONCLUSIONS AND RECOMMENDATIONS

The current spruce budworm outbreak has had a serious economic impact on the forest and resource management agencies on the island of Newfoundland. Estimated impacts resulting from the outbreak to 1978 amounted to over $25.7 million. This was made up of $7.2 million for losses of wood volume ($4.0 million in standing timber and $3.2 million in growth losses); $2.3 million for disruption of normal logging operations; $12.0 million for increased costs of harvesting and processing damaged timber; and $4.2 million for spraying operations, damage assessment surveys and research.

If the possible cost of forest rehabilitation for immature west coast stands is included, the overall estimate of impact increases by up to $22.4 million, to a total of $48.1 million.

The above estimate of impacts is conservative because it does not include certain losses incurred prior to 1977. Nor does it include long term transportation costs and forest rehabilitation costs that will likely be experienced in future years as a result of the outbreak.

Additional economic impact is forecast for 1979 and beyond. The level of impact will depend to a considerable extent on the degree of protection provided to stands in the moderate to high hazard areas.

While the Committee feels it has made progress in developing a framework for evaluating and quantifying economic impacts, it wishes to stress the tentative nature of its estimates and the need for further work on the effects of insect outbreaks on the forests of the Island. The Committee is especially concerned over the long term effects on the forest based industries in western Newfoundland. The forests of the western region, especially between Deer Lake and Port aux Basques, have been especially hard hit. The long term effect on wood supply, transportation costs and possible loss of productive forest area (for softwoods) should be more adequately assessed.

The Committee recommends that a more detailed evaluation be made of the effects of insect outbreaks on the long term wood supply for the mills at Corner Brook and Stephenville.

The final impact of the present outbreak will not be assessed until it has run its course. This is an interim report. It is recommended that the estimates made in this report be updated as new information becomes available, and expanded to include transportation and silvicultural impacts.

Assessment of economic impacts depends upon up-to-date inventory and damage assessment information being available for the areas affected. The present assessment surveys are efficiently conducted and provide good global area and volume estimates for damaged areas. Efforts are now under way to develop an accessibility classification as part of the annual FIDS damage assessment surveys. It is recommended that an accessibility classification be incorporated into the survey in 1979 if possible, because this would greatly assist in the evaluation of economic impacts. An accessibility classification or index (in addition to the present classification of volume by slope class) would also greatly improve the usefulness of Provincial forest inventory data for economic evaluation studies.

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